# CHALLENGES OF THE SECOND SUBMARINE INTERCONNECTION BETWEEN SPAIN AND MOROCCO

Ramon GRANADINO, RED ELECTRICA (Spain), rgranadino@ree.es
Juan PRIETO, RED ELECTRICA (Spain), juprieto@ree.es
Gregorio DENCHE, RED ELECTRICA (Spain), gdenche@ree.es
Fatima MANSOURI, ONE (Morocco), mansouri@one.org.ma
Knut STENSETH, NEXANS (Norway), Knut.Stenseth@nexans.com
Roberto COMELLINI, PRYSMIAN (Italy), roberto.comellini@prysmian.com

## ABSTRACT

*A first Submarine 400 kV Electric Interconnection 28 km long was commissioned in 1997 and represented the first submarine electric line between two continents and a world record reaching a maximum depth of 615 m at that time. The power line has been in commercial operation since May 1998 serving energy market agents on the basis of bilateral short term energy contracts. The two system operators and owners REE (Spain) and ONE (Morocco) launched in 2001 a project calling for the reinforcement of the existing line by the design and construction of a new submarine link that runs in parallel with the existing one. This new circuit provides the additional exchange capacity needed but also contributes to the increase in system security and operation performances. The interconnection which is designed to transmit 700 MW with a thermal overload capability to allow a 900 MW load for 20 minutes was supplied and installed by the Consortium; Nexans Norway AS and Prysmian Cables and Systems (Italy) .*

## KEYWORDS

Submarine power cables, laying and protection techniques, spare cable operation.

## INTRODUCTION

The electrical systems of UCTE and Maghreb were interconnected for the first time in 1997, when the first submarine link between Spain and Morocco was commissioned. The project provided for all the expected benefits of the joint operation of the interconnected systems not only in terms of emergency exchanges and access to energy markets, but also in terms of security and frequency control. The increasing use of the exchange capacity across the link and the extension of cross-border connections between Europe and Northern Africa, within the MEDRING project (Figure 1), called for the extension of the existing line to guarantee the future demands for quality and security of supply.

In 2000 the Spanish and Moroccan Governments requested their Transmission System Operators RED ELECTRICA DE ESPAÑA (REE) and L'OFFICE NATIONALE DE L'ELECTRICITÉ (ONE) to reinforce the interconnection with a second parallel line. The contract for the design and construction of the link was signed on December 9, 2003 (exactly 10 years after the signing of the contract for the realisation of the first interconnection) in Casablanca between REE and ONE on one side and the consortium made by Nexans and Prysmian Cables & Systems (at that time still Pirelli Cables & Systems) on the other. The total cost for the turn-key project was 115 M€, and the interconnection has been commissioned in summer 2006.

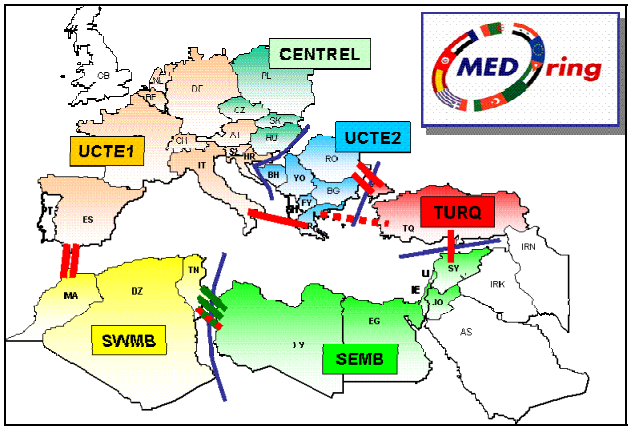


*Figure 1 : Electric Mediterranean Ring, Medring*

The new electrical interconnection - designed for the extension of the existing Spain-Morocco 400 kV AC 4 cables link (with 1 spare cable) in order to double the power transmission capacity - consists of three power cables (paper insulated self contained oil filled) and two fibre optic cables that connect the two systems across the Straits of Gibraltar between Tarifa in Spain and Fardioua in Morocco at a maximum depth of 620 m. The total route length of the link is 31.3 km and includes 2 land sections, one on the Spanish and one on the Moroccan coast, of approximately 2 km and 0.25 km respectively. The submarine cables are terminated at the shore and linked, by means of transition joints, to the land cables, which are connected, in turn, to the terminal stations at both sides of the Straits.

The new line was designed to guarantee a continuous transmission capacity of 700 MW and an emergency rated power limited to 20 minutes of 900 MW, similarly to the first interconnection. The link is operated in alternate current; however the cables used in the interconnection are designed for a possible later conversion to direct current operation, thus offering the possibility of upgrading the interconnection capacity up to 2000 MW.

## ENVIRONMENTAL AND SOCIAL INTEGRATION

The Strait of Gibraltar is a place of great environmental